

Impact of Relevant Knowledge on Purchase Intention of Plant-factory-produced Plants

Case Study in Both Singapore and Japan

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Abstract

This research explored the impact of relevant knowledge on the purchase intention of Plant-factory-produced plants. We conducted surveys and distributed 156 questionnaires (77 males, 79 females) in Singapore, and 42 questionnaires (18 males, 24 females) in Japan. The main questions were regarding whether participants had knowledge of hydroponic plants and whether that knowledge influenced their preference between Plant-factory-produced and farmland-produced plants under three different price levels. Our results showed that, in Singapore, the possession of the relevant knowledge about the Plant Factory could facilitate the purchase of Plant-factory-produced plants. Under all these three price levels, the purchase intention of Plant-factory-produced plants of people with knowledge of hydroponic plants was always higher than that of people without knowledge of hydroponic plants. In Japan, however, knowledge did not significantly influence the participants' purchase intention of Plant-factory-produced plants. Moreover, the price is also an important factor, which can determine the purchase intention of Plant-factory-produced plants both in Singapore and Japan.

Keywords

Plant Factory; Relevant Knowledge; Price; Purchase Intention

Introduction

With the increasing demand of safety, healthy, and nutritive food from consumers, more and more types of edible plants are available on the market. In recent years, a new plant product has come out in Japan as well as in some Western countries—Plant-factory-produced plants (PFPP), which is pesticide-free, and can be eaten directly without washing (Plant Factory Association of Japan, 2012). This research explored the impact of relevant knowledge on the purchase intention of PFPP.

The Plant Factory, a new facility that can use both solar light and artificial light, is based on Hydroponics Technology, in which the plants are cultivated in soilless growing systems, and just supplied with necessary water and nutrients when needed, and CO₂ gas to stimulate photosynthesis. The environments in Plant Factories are controlled by an integrated computer system which can adjust the growing conditions to the best. By this way Plant Factories realize a high productivity and high quality. In addition, by using multiple shelves, Plant Factory can produce vegetables massively even in small space. Since it produces high-quality vegetables steadily all year round, the Japanese government currently is promoting Plant Factory as a very important part of Japanese agriculture (Plant Factory Association of Japan, 2012).

An increasing number of studies have been conducted on the technology and development of Plant Factory (Kato, et al., 2010; Hahn, et al., 1996; Ikeda, et al., 1992; Murase, 2000; Morimoto, et al., 1995). However, it is unclear on whether the usage or application of this new kind of plant product will be well accepted by consumers and what factors influence the purchase intention of Plant-factory-produced plants.

Several factors can influence consumers' purchase intention of a product, such as the product itself, including origin, quality, and brand (Grunert, 2005; Usunier, 1994; Verbeke and Roosen, 2009; Vickers, 1993); market factors, for example, price (Grewal, 1998; Vickers, 1993); advertising (Loef, Antonides, and Raaij, 2001); social factors (Usunier, 1994); environmental factors (Wang and Lamb, 1983); and so on. However, edible plants, as a special kind of products, are always

associated with health and safety, just like food which is tied much concern in recent years (Kurihara, et al., 2010). Especially, in Japan, after the nuclear contamination in 2011, consumers have been paying close attention to the characteristics, origin, and quality of food products. They want to know the accurate and detailed information about the food. Therefore, the relevant knowledge of Plant Factory should have some impact on the purchase intention of edible plants in Japan. The influence of nutritional knowledge on food behaviors has been widely studied (Ares, Giménez and Gámbaro, 2008; Worsley, 2002). In Worsley's study (2002), he pointed out that the relevant knowledge about nutrition was a necessary, but not sufficient factor in changing consumers' food behaviors. Based on this literature thought, it is presumed that the relevant knowledge of Plant Factory might be a necessary, but not sufficient factor that could influence consumers' purchase intention of PFPP.

Methods

Research Objective

This study investigates the impact of relevant knowledge on purchase intention of PFPP in Singapore and Japan. Singapore is selected as our research objective, because it is one of the earliest countries to start selling hydroponic plants (Wilson, 2000). As shown in Table 1, Singapore and Japan have similar geographical environments from an agricultural perspective. They are all islands, with small arable lands, in which the development of Plant Factory is necessary. In addition, the nationals in Singapore and Japan have similar income levels. Therefore, they may have similar attitudes towards purchasing Plant-factory-produced plants. However, they also have different backgrounds and cultures. The data of Singapore will be representative and useful for the development of marketing strategies for PFPP.

TABLE 1 SIMILARITIES BETWEEN SINGAPORE AND JAPAN (MAFF, 2011)

	Singapore	Japan
Arable Land	1.4 %	12.2 %
GDP/ Person	37,394 Dollars	39,864 Dollars

Hypothesis

Worsley (2002) studied and claimed that the relevant knowledge about nutrition could influence the food behavior. And it has been studied that the price is one of the most important factors which could influence consumers' evaluations and purchase intentions (Grewal, 1998). In this study, it is proposed that the relevant knowledge about Plant Factory and the price of Plant-factory-produced plants could influence consumers' purchase intention of Plant-factory-produced plants.

Design

To address these issues, a consumer survey has been conducted. Firstly, the participants were asked whether they had knowledge of hydroponic plants. If they had, they were required to indicate whether or not they liked them, and why. In this way, the participants can be divided into two groups according to their answers: participants with knowledge of hydroponic plants and participants without knowledge of hydroponic plants. Through the comparison of these two groups' differences in the selection of PFPP, it can be verified whether the relevant knowledge has impact on purchase intention of PFPP.

Secondly, three different price situations have been set up: 1) PFPP is 20% more expensive than farmland-produced plants (FPP); 2) PFPP and FPP have the same price; and 3) PFPP is 20% cheaper than FPP. Under these three price levels, the participants were asked to select which plants they preferred (PFPP or FPP) for each following usage application: Tomato for Eating, Lettuce for Eating, Herbs for Internal Use, and Herbs for External Use. There are two purposes to set these questions. First of all, we can verify the influence of price on purchase intention of PFPP (comparison under three price levels). Secondly, we can compare the differences between participants with knowledge of hydroponic plants and participants without that under different prices. Excluding the impact of price, we can better observe the role of relevant knowledge in influencing the purchase intention of PFPP.

We chose Tomato for Eating, Lettuce for Eating, Herbs for Internal Use, and Herbs for External Use as stimuli in this experiment for the following reasons. Firstly, tomatoes, lettuce, and herbs are the main products of the Plant Factory in Japan (Plant Factory Association

of Japan, 2012) and hydroponic farms in Singapore (Wilson, 2000). Secondly, these four stimuli we chose are in different risk levels (internal vs. external, vegetables vs. herbs), and so we could examine whether consumers' attitudes toward PFPP differed because of risk levels.

Participants

We designed our survey in a manner that would preserve participant anonymity. Specifically, participant responses were not observable by anyone, including the experimenter. In order to gather information, we conducted both a paper survey, in which participants at the university level voluntarily provided answers without observation, and an online survey. Both surveys required participants to omit their names and personal information.

Before participants began the survey, we informed them that they would be asked about their ideas on purchasing plants, and then they were required to read a short introduction of Plant Factory so that they could learn about the characteristics of Plant-factory-produced plants. In February and March 2012, a total of 156 Singaporeans: 97 students (51 males/46 females) and 59 citizens (26 males/33 females), and 42 Japanese university students (18 males/24 females) completed this survey. The study was approved both by Nanyang Technological University and Chiba University.

Results

Knowledge of Hydroponic Plants

In Singapore, approximately 61% of participants had some knowledge of hydroponic plants and 39% had no knowledge of hydroponic plants, while in Japan, approximately 26% of participants had some knowledge of hydroponic plants and 74% had no knowledge of hydroponic plants (Figure 1). Most of the participants familiar with hydroponic plants liked them: 89% in Singapore and 85% in Japan. As shown in Figure 2, pesticide-free and edible without washing were the main reasons why those participants liked hydroponic plants.

The Influence of Price on the Purchase Intention of PFPP

As shown in Figure 3 and Figure 4, the price determined

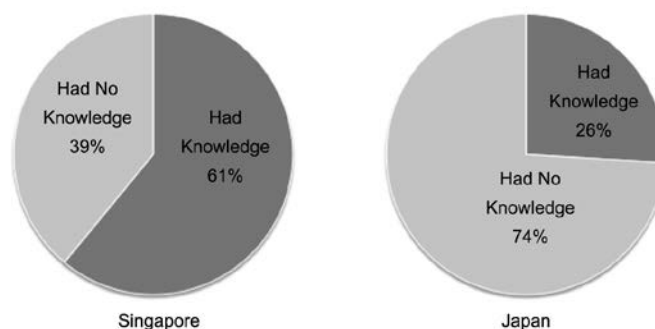


FIG. 1 PERCENTAGE OF PARTICIPANTS WITH KNOWLEDGE OF HYDROPONIC PLANTS

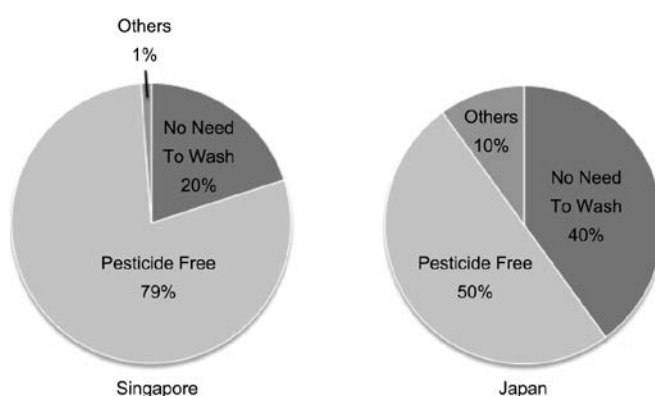


FIG. 2 WHY THE PARTICIPANTS WITH KNOWLEDGE OF HYDROPONIC PLANTS LIKED THEM

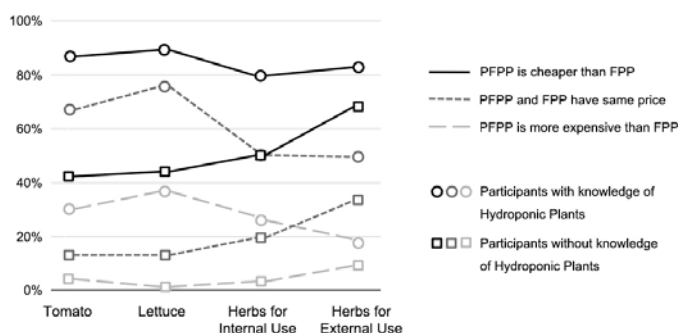


FIG. 3 THE PURCHASE INTENTION OF PFPP IN SINGAPORE

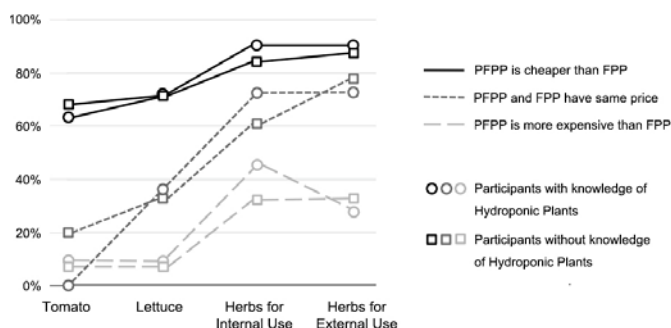


FIG. 4 THE PURCHASE INTENTION OF PFPP IN JAPAN

the purchase intention of PFPP both in Singapore and in Japan. Along with the price reduction, the purchase intention of PFPP increased.

The Influence of Relevant Knowledge on the Purchase Intention of PFPP

In order to verify whether the relevant knowledge could influence the purchase intention of Plant-factory-produced plants, the participants were divided into two groups based on their answers: people with knowledge of hydroponic plants and people without knowledge of hydroponic plants. We determined the percentage of participants in each group that was willing to purchase PFPP and compared them using the same coordinate system.

In Singapore, for all the usages, the purchase intention of PFPP of people with knowledge of hydroponic plants was always higher than that of people without knowledge of hydroponic plants, under all three prices (Figure 3). We obtained further information pertaining to each usage at each price level based on 2×2 χ^2 tests (Chi-Square tests) among participants in both categories. Regarding the purchase of edible plants (tomato, lettuce, and herbs for internal use), significant differences were observed between people with knowledge of hydroponic plants and those without this knowledge, under all prices. Specifically, people with knowledge of hydroponic plants were significantly more willing to purchase PFPP than those without this knowledge whenever PFPP was cheaper, the same or more expensive compared to FPP with (tomato: $\chi^2 (1, N = 156) = 35.33, p < .01$; lettuce: $\chi^2 (1, N = 156) = 37.50, p < .01$; herbs for internal use: $\chi^2 (1, N = 156) = 14.68, p < .01$) (tomato: $\chi^2 (1, N = 156) = 44.00, p < .01$; lettuce: $\chi^2 (1, N = 156) = 58.41, p < .01$; herbs for internal use: $\chi^2 (1, N = 156) = 14.94, p < .01$). and (tomato: $\chi^2 (1, N = 156) = 14.94, p < .01$; lettuce: $\chi^2 (1, N = 156) = 25.93, p < .01$; herbs for internal use: $\chi^2 (1, N = 156) = 13.78, p < .01$), respectively.

The results in Japan differed from those obtained in Singapore. For each usage under all prices, insignificant differences were observed between the participants with knowledge of hydroponic plants and those without knowledge of hydroponic plants. Specifically, the purchase intention of PFPP of people with knowledge of hydroponic plants was insignificantly different from that of those without this knowledge whenever PFPP was cheaper, the same or more expensive compared to FPP with (tomato: $\chi^2 (1, N = 42) = 0.06, p = .54$; lettuce: $\chi^2 (1, N = 42) = 0.01, p = .62$; herbs for internal use: $\chi^2 (1, N = 42) = 0.33, p = .50$; herbs for external use: $\chi^2 (1, N = 42) = 0.11, p = .61$)

(tomato: $\chi^2 (1, N = 42) = 2.48, p = .14$; lettuce: $\chi^2 (1, N = 42) = 0.06, p = .54$; herbs for internal use: $\chi^2 (1, N = 42) = 0.46, p = .38$; herbs for external use: $\chi^2 (1, N = 42) = 0.10, p = .52$) and (tomato: $\chi^2 (1, N = 42) = 0.09, p = .61$; lettuce: $\chi^2 (1, N = 42) = 0.09, p = .61$; herbs for internal use: $\chi^2 (1, N = 42) = 0.62, p = .33$; herbs for external use: $\chi^2 (1, N = 42) = 0.09, p = .54$), respectively.

In addition, in Singapore, the purchase intention of Plant-factory-produced vegetables (tomatoes, lettuce) of people with knowledge of hydroponic plants was always higher than the purchase intention of Plant-factory-produced herbs, under all three prices (see Figure 3). In contrast, the purchase intention of Plant-factory-produced vegetables (tomatoes, lettuce) of people without knowledge of hydroponic plants was always lower than the purchase intention of Plant-factory-produced herbs, under all three prices (see Figure 3).

Different from the results in Singapore, the purchase intention of Plant-factory-produced vegetables (tomato, lettuce) of Japanese participants was always lower than the purchase intention of Plant-factory-produced herbs, under all three prices, no matter whether they had knowledge of hydroponic plants or not.

Discussion

The Influence of Price on the Purchase Intention of PFPP

Previous studies that examined consumers' intentions to purchase food products have indicated that price was one of the major factors in participants' purchase intentions and that low-priced products were preferred (Vickers, 1993; Grewal, 1998). In this study, we also confirmed this point and found that, in both Singapore and Japan, price determined the consumers' purchase intention of plants. In order to motivate consumers to purchase PFPP more, controlling price should be an effective method.

The Influence of Relevant Knowledge on the Purchase Intention of PFPP

According to Worsley (2002), relevant knowledge about nutrition could influence food behavior. In our study, we obtained similar results in Singapore. The purchase intention of Plant-factory-produced edible plants of people with knowledge of hydroponic plants was significantly higher than that of people without

knowledge of hydroponic plants. However, they preferred or did not prefer PFPP for the same reason—safety and health. People with knowledge of hydroponic plants preferred PFPP because they are pesticide-free (Figure 2). On the other hand, people without knowledge of hydroponic plants chose FPP, because they suspected that PFPP is unhealthy. Knowledge of hydroponic plants also influenced the attitudes of the participants toward the uses of PFPP. People with knowledge of hydroponic plants accepted the use of PFPP as vegetables better than their use as herbs, because they knew the production method of PFPP and thought PFPP had lower medical effects than FPP. People without knowledge of hydroponic plants accepted the use of PFPP as herbs better than their use as vegetables.

In contrast, our results in Japan were different from those in Singapore. Overall, insignificant difference was observed between two groups with and without knowledge of hydroponic plants. The different results in Singapore and Japan may be explained by Japanese consumer attitudes dependent more strongly on the government regulatory system of food safety than on their own knowledge about food (Kim, 2010).

After the nuclear contamination in 2011 in Japan, consumers have been paying close attention to the characteristics, origin, and quality of food products. We thought the relevant knowledge of Plant Factory should help them make decision in selecting plants. The results went contrary to our hypothesis. However, this does not mean that relevant knowledge has no influence on the purchase intention of PFPP in Japan and that Japanese participants are not concerned about food safety. As Worsley (2002) suggested, relevant knowledge was a necessary, but not sufficient, factor in changing consumers' food behaviors. Food behaviors are also influenced by a number of environmental, intra-individual, and other kinds of factors. Further studies are needed to examine what factors have a stronger influence on the purchase intention than relevant knowledge does in Japan.

Conclusions

It is concluded that the relevant knowledge about the Plant Factory plays an important role in influencing consumers' purchase intention of Plant-factory-produced plants in Singapore, whereas it does not significantly influence consumers' purchase intention

of Plant-factory-produced plants in Japan. In addition, the price is an important factor that can determine the consumption of Plant-factory-produced plants in both Singapore and Japan. It is also found that the purchase intention increased when the price reduced.

Based on the results of this study, since the informative elements (relevant knowledge) did not significantly influence the purchase intention of PFPP in Japan, we plan to analyze other possible elements influencing the purchase of PFPP in Japan. Emotional conditions are always present and influence every stage of decision-making in the purchase process (Consoli, 2009), which may motivate consumers' purchase of PFPP. In our future studies, we will design experiments to test and compare which factors, informative or emotional, have a strong influence on the purchase of Plant-factory-produced plants in Japan.

ACKNOWLEDGMENT

We thank the Japan Student Services Organization for their financial support for our research in Singapore. This study is also funded by Grants-in-aid for Scientific Research (B) (Project # 22300072) to HH and SK.

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